MONTANA DEPARTMENT OF FISH, WILDLIFE AND PARKS

FISHERIES DIVISION
JOB PROGRESS REPORT

STATE: Montana

PROJECT TITLE: Statewide Fisheries Investigations

PROJECT NO: F-46-R-7

STUDY TITLE: Survey and Inventory of Coldwater Streams

JOB NUMBER: I-O

JOB TITLE: Upper Clark Fork EPP

PROJECT PERIOD: July 1, 1993 through June 30, 1994.

ABSTRACT

Ages of mountain whitefish and brown trout determined from their scales agreed with ages determined from their otoliths in 97% and 87% of sample comparisons, respectively.

Brown trout abundance based on June samples showed the same pattern of downstream decrease that has been apparent for at least the last seven years in the upper Clark Fork river. Brown trout abundance in lower portions of Flint Creek and the Little Blackfoot river was generally similar each season in each stream between 1990 and 1992, however sampling errors are large.

Recaptures of brown trout from 1989 to 1992 show that most fish remain in river areas near where they are marked. Among those fish that move, many move upstream or into tributaries in the fall. Spring movements are predominantly downstream.

Invertebrate samples from riffles in Cottonwood Creek at the Grant Kohrs Ranch National Historic Site contained surprisingly abundant amphipods. Over 89% of organisms in each sample were Hyalella azteca or Gammarus lacustris. Rarer species were diverse.

OBJECTIVES AND DEGREE OF ATTAINMENT

1. Collect, compile, and analyze fish population and habitat data on the Clark Fork and its tributaries.

New data collections, compilations, and analyses reported here include:

A. Comparison of mountain whitefish [1] and brown trout ages obtained from scale and otolith aging techniques.

B. Estimates of brown trout abundance in the Clark Fork river based on mark recapture sampling in June, 1994.

C. Estimates of brown trout abundance in Flint Creek and the Little Blackfoot river based on mark recapture sampling in 1990, 1991 and 1992.

D. Brown trout movement in the Clark Fork basin based on tag return information from marked fish recaptured between 1989 and 1992.

E. Invertebrate sampling in Cottonwood Creek at the Grant Kohrs Ranch National Historic Site.

2. Assist in bringing the Natural Resource Damage Claim (NRDC) against the Atlantic Richfield Company (ARCO) to a conclusion in favor of an improved trout fishery in the Clark Fork River.

Items listed under objective 1 pertain to objective 2. In addition, I assisted consultants with mark recapture fish population surveys and a temperature study of the river (in progress).

At this time litigation is stayed and negotiations towards a settlement of claims continue. Negotiating sessions are scheduled to end September 15, 1994.

---

[1] Common names are used in this report. Binomial designations are listed in Appendix A.

PROCEDURES

A. Mountain whitefish and brown trout ages obtained from scale and otolith aging techniques.

I compared fish ages from otoliths and scales to see if results from the scale aging technique used in earlier reports (e.g. Tohtz 1992; Tohtz 1993) were consistent with a different aging technique. This assessment was undertaken in part to address the well established need for age validation in age studies of fish (e.g. Beamish and McFarlane 1983). I used otoliths and scales from 31 mountain whitefish collected in October, 1993. These fish were ripe spawners that had been stranded in pools during reconstruction of the Mill-Willow bypass. I also used otoliths and scales from 15 brown trout that had been killed for tissue samples in December, 1992.

Age was determined from scales by counting annuli on acetate impressions after projecting them on a microfiche reader. Annuli were recognized by overcutting, changes in angle of formation, and circuli continuous between the anterior and posterior scale fields. Annuli were considered complete only if circuli beyond the annulus indicated renewed growth.

Age was determined from otoliths by counting annual marks on saggitae. Direct light transmission was adequate for most bones; some of the thicker brown trout otoliths were cracked and then heated in an alcohol flame (e.g. Christensen 1964) to enhance the contrast between annual marks.

B. Estimates of brown trout abundance in the Clark Fork river based on mark recapture sampling in June, 1994.

Six reaches of the Clark Fork river were sampled cooperatively with ARCO consultants in June (Table 1). These reaches are the same used by ARCO consultants since 1989 referred to in earlier reports (e.g. Spoon 1990; Tohtz 1992). Reach 1 and Reach 4 were shorter this year than in previous years because portions of each reach had been sampled earlier by the Montana Department of Fish Wildlife and Parks (MDFWP); these data were given to ARCO consultants.

Table 1. Descriptions of reaches sampled during mark recapture surveys of the Clark Fork River in June, 1994.

Reach	Description	Approximate length (m)
1	Job corp ponds to Perkins Lane	2,071
2	Perkins Lane to near mouth of Lost Creek	3,486
3	Sager Lane to about 3 miles downstream	4,466
4	Deer Lodge sewage plant to vet clinic	1,770
6	Mouth of L. Blackfoot to Phosphate bridge	8,272
8	Robinson's boat launch to Bear Gulch	6,521

Fish were captured in each sampling section with a rubber raft equipped with a spherical cathode suspended from the boat, and a spherical anode mounted on an adjustable boom at the bow. A 5000 watt generator was used with a Coffelt Model VVP-15 rectifying unit.

Fish were collected in live cars, identified, measured to the nearest 1.0 mm (total length), and weighed to the nearest 10.0 g. Trout were marked with fin clips, and Floy tags if fish were larger than about 200 mm total length. All fish were returned to the stream after marking. Recapture sampling was conducted about one week later in each section.

Data were analyzed using MarkRecapture 4.0, a computer program developed by MDFWP for processing electrofishing records. Fish abundance is calculated using a log-likelihood estimator.

C. Estimates of brown trout abundance in Flint Creek and the Little Blackfoot river based on mark recapture sampling in 1990, 1991 and 1992.

Between 1990 and 1992, brown trout were sampled in summer, fall and spring in Flint Creek near the New Chicago bridge, and in two sections of the Little Blackfoot river located less than five miles from the river mouth. These streams are two of the largest tributaries of the upper Clark Fork river.

Fish were sampled either with electrofishing gear on a rubber raft as described in PROCEDURES, section B, or with gear mounted on a small boat. This latter included a 5000 watt generator and a Coffelt Model VVP-15 rectifying unit. The cathode was cables suspended from the bow of the boat; the anode was a single hand held electrode connected to the power source by about 10 m of cable.

Fish were collected in live cars, identified, measured to the nearest 1.0 mm (total length), and weighed to the nearest 10.0 g. Trout were marked with fin clips, and Floy tags if fish were larger than about 200 mm total length. All fish were returned to the stream after marking. Recapture sampling was conducted about two weeks later in each section.

Data were analyzed using MRSYS, a computer program developed by MDFWP for processing electrofishing records. Population estimates are calculated using the Chapman (1951) modification of the Petersen estimate.

D. Brown trout movement in the Clark Fork basin based on tag return information from marked fish recaptured between 1989 and 1992.

Over 21,000 brown trout have been marked with numbered Floy tags in the upper Clark Fork river and its tributaries since regular mark recapture sampling by ARCO consultants began in 1989. These tags provide unique identifiers for individual fish. Records of recapture dates and locations were reviewed to assess patterns of fish movement in the mainstem river and between the river and its tributaries. Analysis is restricted to movements between different ARCO sampling reaches in the mainstem river, and between those sampling reaches and different sample sites in various Clark Fork tributaries. Tag returns from anglers were not included, which limits recaptures to those made during electrofishing surveys over this four year period.

E. Invertebrate sampling in Cottonwood Creek at the Grant Kohrs Ranch National Historic Site.

Invertebrates were collected at two sites in Cottonwood Creek where it flows through the Grant Kohrs Ranch National Historic Site at Deer Lodge. This sampling was conducted October 22, 1992 in conjunction with the development of a public trail along the creek.

The first site was located 30 m downstream from where the creek first enters the park. The second site was located 170 m further downstream. A single kick sample was collected at each site by continuously disturbing the substrate back and forth between banks in a riffle for 60 seconds. Mesh size of the kick net was 1.0 mm. Samples were preserved in 95% ethyl alcohol. Invertebrates were separated and sorted initially using a dissecting microscope. Invertebrates were later counted and identified to species whenever possible. Examples of each taxon identified in these samples were preserved separately in glass viles. Examples of chironomid larvae were preserved on microscope slides. This reference collection will remain at Grant Kohrs Ranch.

RESULTS AND DISCUSSION

A. Mountain whitefish and brown trout ages obtained from scale and otolith aging techniques.

Only one mountain whitefish and two brown trout had different ages when aged from scales than when aged from otoliths. In each of these cases the age from the otolith was less than the age from the scale (Table 2; Table 3).

Table 2. Age of mountain whitefish based on scale and otolith aging techniques.

Sex	TL[a] (mm)	Scale age	Otolith age	Sex	TL (mm)	Scale age	Otolith age
F	308	3	3	M	270	2	2
F	310	3	3	M	293	3	3
F	310	3	3	M	293	2	2
F	310	3	3	M	298	3	3
F	313	3	3	M	304	3	3
F	314	3	3	M	305	3	3
F	322	3	3	M	305	3	3
F	326	3	3	M	309	3	3
F	333	3	3	M	309	3	3
F	334	3	3	M	310	3	3
F	334	3	3	M	311	3	3
F	341	3	3	M	316	3	3
F	345	4	4	M	319	3	3
F	362	4	4	M	321	3	3
F	378	4	4	M	380	4	4
F	387	4	4	M	394	4	4
F	345	4	3[b]				
mean = 334		SD = 23		mean = 315		SD = 30	

a Total length
b Scale and otolith ages differ

Table 3. Age of brown trout based on scale and otolith aging techniques.

TL[a] (mm)	Scale age	Otolith age	TL (mm)	Scale age	Otolith age
267	2	2	353	4	3 [b]
267	2	2	361	3	3
320	2	2	363	3	3
330	2	2	363	3	3
333	3	3	368	3	3
335	3	3	399	4	4
343	3	3	462	5	5
343	3	2 [b]			

a Total length
b Scale and otolith ages differ

B. Estimates of brown trout abundance in the Clark Fork river based on mark recapture sampling in June, 1994.

Since at least 1987, brown trout numbers in the upper Clark Fork river have been highest in sections immediately below the Warm Springs Ponds (ARCO Reach 0 and Reach 1). Fish numbers decrease precipitously downstream (Hadley 1989; Spoon 1990; Tohtz 1992). Surveys conducted since 1989 between Perkins Lane and Phosphate (between ARCO Reach 2 and Reach 6) have large sample errors that obscure downstream trends in fish abundance. However, fish numbers typically are much less in these downstream areas compared to Reach 1 and Reach 0 (Tohtz 1992). This pattern was repeated again in 1994 (Table 4). Results for Reach 3 are omitted because the time between mark and recapture sampling was too short to justify the estimate. Estimates for Reach 1 and Reach 8 are also omitted because low numbers of recaptures produced unreliable results.

Table 4. Brown trout abundance in three reaches of the Clark Fork river based on mark recapture sampling in June.

			Overall model			Pooled sample		
Reach	N[a]	SD[b]	DF[c]	Chi-square	P[d]	DF	Chi-square	P
2	461	89	9	5.95	0.74	6	5.40	0.49
4	351	151	6	12.61	0.05	1	1.59	0.21
6	140	44	9	14.31	0.11	6	8.32	0.22

a Number of fish/km
b Standard deviation
c Degrees of freedom
d Probability value

C. Estimates of brown trout abundance in Flint Creek and the Little Blackfoot river based on mark recapture sampling in 1990, 1991 and 1992.

No difference in brown trout abundance in the lower reaches of these tributaries is demonstrated by these data because sampling errors are large (Table 5). It seems likely that these lower reaches are strongly influenced by fish movements from the mainstem river. Perhaps these lower sections do have stable numbers as is true of most sections of the mainstem river (Tohtz 1992). However, it is also possible that fish numbers vary considerably each season and each year, as is more characteristic of smaller tributaries in the upper Clark Fork drainage (Tohtz 1993). Sampling is not adequate so far to distinguish between these possibilities.

Table 5. Brown trout abundance in Flint Creek and the Little Blackfoot river based on mark recapture sampling in 1990, 1991, and 1992.

River: section	Section length (m)	Fish per section	Standard deviation	Survey date
Flint Creek:				
New Chicago[a]				
	1018	434	36	07/17/90
		443	98	11/07/90
		372	25	08/02/91
		599	92	04/23/92
Little Blackfoot:				
Lower[b]				
	1014	65	38	07/16/90
		203	84	11/05/90
		230	102	07/17/91
		972	610	10/03/91
Upper[c]				
	867	125	42	07/16/90
		131	41	11/05/90
		354	166	07/17/91
		473	169	10/03/91

a New Chicago section is located T10N, R12W, S7D
b Lower section is located T09N, R09W, S19A
c Upper section is located T09N, R09W, S16A

D. Brown trout movement in the Clark Fork basin based on tag return information from marked fish recaptured between 1989 and 1992.

Over 71% of brown trout recaptured in Clark Fork sampling reaches were caught in the same area of the river where they were marked (Table 6). Most fish marked in tributaries were also recaptured where they were marked (Table 7), with two exceptions. Fish marked in the Mill-Willow bypass above the Pond 2 outfall were recaptured in upper reaches of the Clark Fork river or in other tributaries (Table7; Table 8), but never in the bypass if sampling occurred more than one month after tags were placed. Similarly, fish marked in Mill creek were not recaptured in Mill creek if recapture sampling occurred more than one month later. Sampling was less consistent in tributaries than in the mainstem river between 1989 and 1992 (Tohtz 1992; Tohtz 1993), perhaps explaining this result.

Table 6. Number of brown trout recaptured in the Clark Fork mainstem that had been marked in the mainstem between 1989 and 1992. Numbers do not include fish recaptured less than one month after being marked.

Recapture area:(ARCO reaches)	Mark area:(ARCO reaches)											
	0	1	2	3	4	5	6	7	8	9	10	Total
0	258	66	15	0	2	1	1	3	2	1	0	349
1	62	232	28	5	7	1	1	2	0	0	2	340
2	17	39	30	7	6	1	0	0	0	0	0	100
3	3	3	5	70	5	2	1	1	0	0	1	90
4	2	2	5	2	148	14	5	5	0	0	0	183
5	0	12	3	1	14	63	13	2	0	0	0	94
6	1	2	2	3	3	12	137	25	0	0	0	185
7	0	0	0	1	0	3	17	63	2	0	0	86
8	0	0	0	0	1	0	0	2	21	3	0	26
9	0	0	0	0	0	0	0	1	2	13	0	16
10	0	0	0	0	0	0	0	2	0	0	7	9
Total	313	345	88	89	186	97	175	101	27	17	12	1478

Table 7. Number of brown trout recaptured in Clark Fork tributaries that had been marked in tributaries between 1989 and 1992. Numbers do not include fish recaptured less than one month after being marked.

Recapture area: Clark Fork tributaries	Mark area: Clark Fork tributaries (letters refer to streams in left column)									
	A	B	C	D	E	F	G	H	I	Total
A) Willow	34	2	18	0	0	0	0	0	0	54
B) Mill	0	0	9	0	0	0	0	0	0	9
C) MW Bypass	0	0	0	0	0	0	0	0	0	0
D) Warm Springs	1	0	0	123	0	0	0	0	0	124
E) Lost	0	0	0	0	11	0	0	0	0	11
F) Racetrack	0	0	0	0	0	59	0	0	0	59
G) L.Blackfoot	0	0	0	1	0	0	50	0	0	50
H) Gold	0	0	0	0	0	0	0	58	0	58
I) Flint	0	0	0	1	0	0	0	0	119	120
Total	34	2	27	125	11	59	50	58	119	485

Table 8. Number of brown trout recaptured in the Clark Fork mainstem that had been marked in tributaries between 1989 and 1992. Numbers do not include fish recaptured less than one month after being marked.

Recapture area: (ARCO reaches)	Mark area: Clark Fork tributaries							
	Mill	MWBY	WMSP	Lost	RACE	LTBR	Gold [a]	Total
0	1	25	39	0	0	0	0	65
1	1	6	45	3	0	0	0	55
2	0	2	3	0	0	0	0	5
3	0	1	1	0	0	0	0	2
4	0	0	0	1	0	0	0	1
5	0	0	0	0	0	7	1	8
6	0	0	0	1	5	0	0	6
7	0	0	1	0	0	2	7	10
8	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0
10	0	0	0	0	0	1	0	1
Total	2	34	89	5	5	10	8	153

a MWBY = Mill-Willow bypass above the Pond 2 outfall, WMSP = Warm Springs creek, RACE = Racetrack creek, LTBR = Little Blackfoot river.

Many fish caught outside areas where they were marked moved upstream or into tributaries in the fall (Figure 1). These movements correspond to spawning activity. Recaptures were highest in Warm Springs creek, the Little Blackfoot river, and Gold creek (Table 9). Very few fish marked in the mainstem river were ever recaptured in Flint creek.

Fish moved out of tributaries between fall and spring sampling periods. Trapping results in some tributaries indicate fish move out of tributaries just prior to peak spring runoff (Tohtz 1992). Fish in the mainstem river were about equally likely to move upstream or downstream at this time.

In late spring, fish in the mainstem river primarily moved downstream (Figure 2). No fish were recaptured moving out of tributaries at this time.

Fish that were recaptured more than one year after their release were usually found upstream from areas where they were marked (Figure 3).

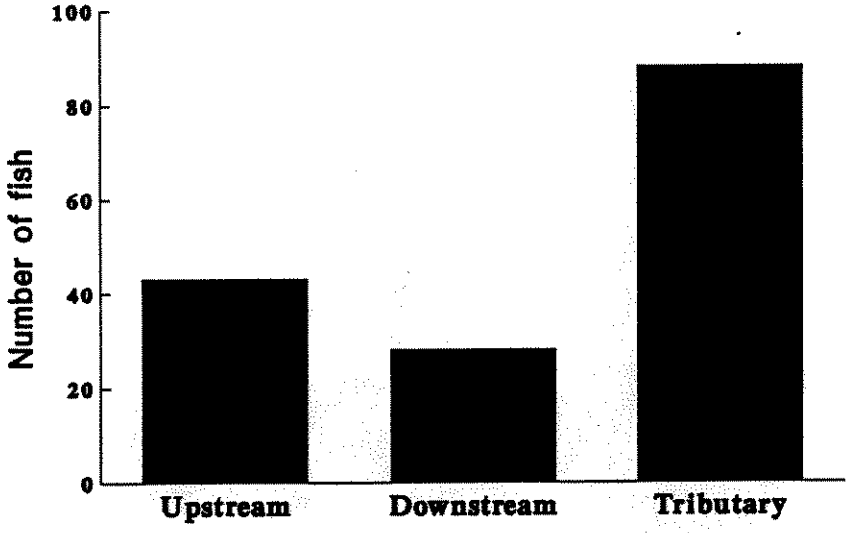

Figure 1. Fall movements of brown trout based on recaptures of fish marked in the mainstem Clark Fork river.

Table 9. Number of brown trout recaptured in Clark Fork tributaries that had been marked in the mainstem river between 1989 and 1992. Numbers do not include fish recaptured less than one month after being marked.

Recapture area: Clark Fork tributaries	Mark area: (ARCO reaches)											
	0	1	2	3	4	5	6	7	8	9	10	Total
Willow	3	1	0	0	0	0	0	0	0	0	0	4
Mill	0	0	0	0	0	0	0	0	0	0	0	0
MW Bypass	11	6	0	0	0	0	0	0	0	0	0	17
Warm Springs	13	39	0	0	0	1	0	0	0	0	0	53
Lost	0	0	0	0	1	0	0	0	0	0	0	1
Racetrack	0	0	0	2	5	0	0	0	0	0	0	7
L.Blackfoot	0	0	0	1	4	6	8	5	1	0	1	26
Gold	0	0	0	0	1	0	4	23	0	0	0	28
Flint	0	0	0	0	0	0	1	0	1	0	0	2
Total	27	46	0	3	11	7	13	28	2	0	1	138

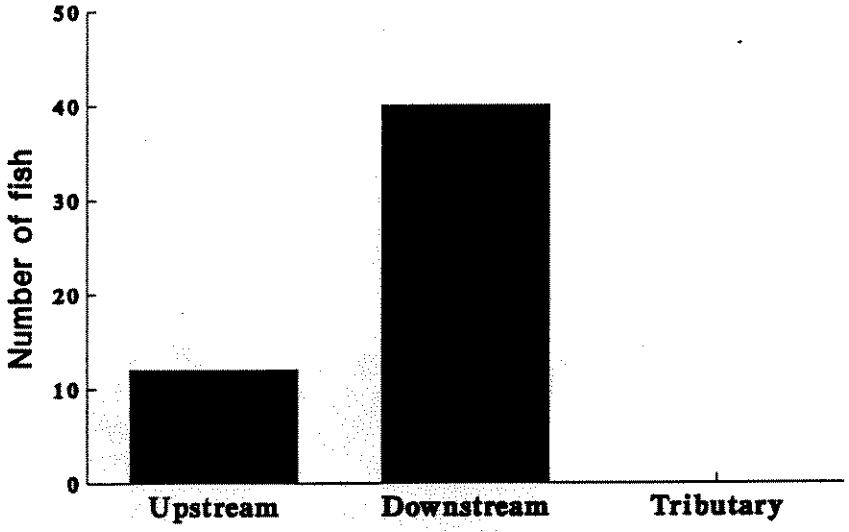

Figure 2. Spring movements of brown trout based on recaptures of fish marked in the mainstem Clark Fork river.

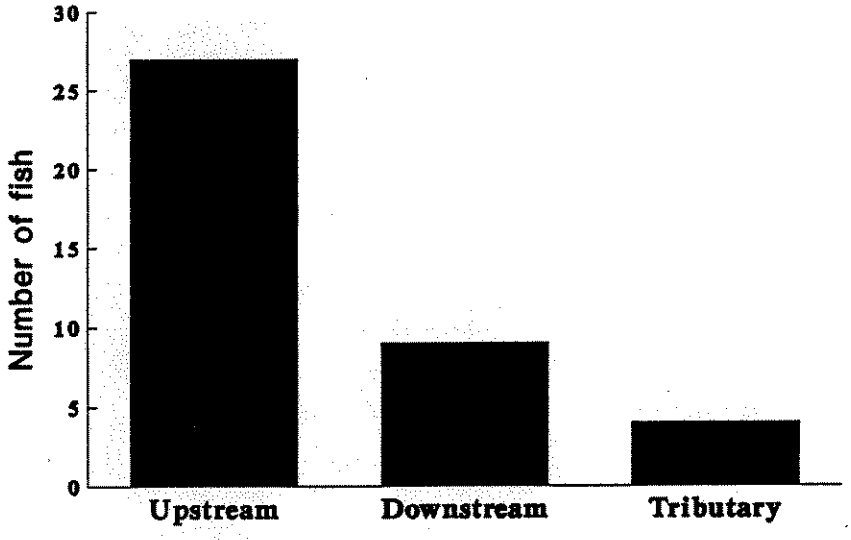

Figure 3. Brown trout movements based on recaptures of fish more than one year after they were marked in the mainstem Clark Fork river.

E. Invertebrate sampling in Cottonwood Creek at the Grant Kohrs Ranch National Historic Site.

Invertebrate types at each site were diverse. Both sites were dominated by large numbers of amphipods (Hyalella azteca, Gammarus lacustris) even though collections had been made in riffles (Table 10; Table 11). The creek gradient is very low inside the National Park boundary and the creek is intercepted at its mouth by an irrigation canal. The backwater influence of this canal may partly explain the abundance of amphipods. Fish thrive in this creek and it represents a potential new source of recruitment for the Clark Fork if the creek can ever be reconnected to the mainstem river.

Table 10. Invertebrates in the upstream sample from Cottonwood Creek, October 22, 1992.

Taxon	Number	Relative abundance (percent)
Coleoptera		
Optiservus sp.	1	0.24
Trichoptera		
Cheumatopsyche sp.	12	2.90
Hydropsyche sp.	5	1.20
Hesperophylax sp.	2	0.48
Plecoptera		
Pteronarcella sp.	4	0.97
Ephemeroptera		
Ephemerella inermis	1	0.24
Annelida		
Lumbriculicidae	2	0.48
Helobdella stagnalis	2	0.48
Helobdella fusca	1	0.24
Odonata		
Coenagrionidae	4	0.97
Gastropoda		
Physa sp.	1	0.24

(Continued)

Table 10. Invertebrates in the upstream sample from Cottonwood Creek, October 22, 1992 (Continued from page 15).

Amphipoda		
Hyallela azteca	72	17.40
Gammarus lacustris	296	71.70
Diptera		
Chironomidae		
Tvetenia sp.	3	0.73
Corynoneura sp.	2	0.48
Larsia sp.	3	0.73
Eukiefferiella sp.	5	1.20
Tanytarsus sp.	1	0.24
Paratendipes sp.	1	0.24
Polypedilum sp.	1	0.24

Table 11. Invertebrates in the downstream sample from Cottonwood Creek, October 22, 1992.

Taxon	Number	Relative abundance (percent)
Coleoptera		
Optiservus sp.	9	1.30
Trichoptera		
Cheumatopsyche sp.	9	1.30
Hydropsyche sp.	1	0.15
Oecetis sp.	1	0.15
Lepidostoma sp.	1	0.15
Annelida		
Lumbriculicidae	3	0.45
Helobdela stagnalis	1	0.15
Odonata		
Coenagrionidae	4	0.60
Gastropoda		
Physa sp.	2	0.30

(Continued)

Table 11. Invertebrates in the downstream sample from Cottonwood Creek, October 22, 1992 (Continued from page 16).

Amphipoda			
	Hyallela azteca	408	61.00
	Gammarus lacustris	202	30.20
Diptera			
	Simulium sp.	2	0.30
	Chironomidae		
	Eukiefferiella sp.	4	0.60
	Tanytarsus sp.	4	0.60
	Cricotopus/Orthocladius sp.	17	2.50

Prepared by: Joel Tohtz

Date: July, 1994

Waters referred to:

Clark Fork River
Mill Creek
Willow Creek
Mill-Willow Bypass
Warm Springs Creek
Racetrack Creek
Lost Creek
Cottonwood Creek
Little Blackfoot
Gold Creek
Flint Creek

REFERENCES

Beamish, R.J. and G.A. McFarlane. 1983. The forgotten requirement for age validation in fisheries biology. Transactions of the American Fisheries Society 112:735-743.

Chapman, D.G. 1951. Some properties of the hypergeometric distribution with applications to zoological censuses. University of California Publications in Statistics 1:131-160.

Christensen, J.M. 1964. Burning of otoliths, a technique for age determination of soles and other fish. Journal du Conseil pour L'Exploration de la Mer 29:73-81.

Hadley, W.F. 1989. Survey and inventory of coldwater streams: upper Clark Fork River study. Job progress report. Project F-46-R-1, no. I-C. Montana Department of Fish, Wildlife & Parks, Missoula.

Spoon, R. 1990. Outline of fisheries activities relating to the natural resource damage assessment: Clark Fork River. Progress report. Montana Department of Fish, Wildlife & Parks, Missoula.

Tohtz, J. 1993. Survey and inventory of coldwater streams: upper Clark Fork EPP. Job progress report. Project F-46R-5, no. I-O. Montana Department of Fish, Wildlife, and Parks, Missoula.

Tohtz, J. 1992. Survey and inventory of coldwater streams: upper Clark Fork EPP. Job progress report. Project F-46R-5, no. I-O. Montana Department of Fish, Wildlife, and Parks, Missoula.

APPENDIX A

Table A1. Common names and binomial designations of fish referred to in this report.

Common name	Scientific name
Brook Trout	*Salvelinus fontinalis*
Brown Trout	*Salmo trutta*
Largescale Sucker	*Catostomus macrocheilus*
Longnose Sucker	*Catostomus catostomus*
Mountain Whitefish	*Prosopium williamsoni*
Rainbow Trout	*Oncorhynchus mykiss*
Redside Shiner	*Richardsonius balteatus*
Westslope Cutthroat	*Oncorhynchus clarki lewisi*